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The Perceived Attributes of Wi-Fi Technology and the Diffusion Gap among University Faculty Members: A Case Study

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Abstract:

The purpose of this case study is to investigate and understand the perceived attributes of Wi-Fi technology and the diffusion gap among university faculty members. Rogers' diffusion theory provides the theoretical framework to guide the qualitative study.

Semi-structured interviews were used to collect data. The participants were 16 faculty members (nine adopters and seven non-adopters) from six colleges at a midwestern state university. Findings from this study show the differences between early adopters and non-adopters (the mainstream) in these aspects: knowledge and skill of technology, teaching practices, teaching philosophy, and technology needs. These different perceptions toward Wi-Fi technology lead to diffusion "gap" between early adopters and the mainstream.

This diffusion gap implies that a different support infrastructure is needed for mainstream faculty to integrate technology for teaching and learning. An institution needs to act as a change agent to promote further technology adoption by the mainstream faculty.

Keywords: IT diffusion and adoption, case study, instructional technology

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I. INTRODUCTION

Wi-Fi technology is quickly gaining a foothold on many campuses as a means to achieve mobility and anywhere, anytime access. Data from the Campus Computing Project annual national surveys of information technology in U.S. higher education reveal the continuing expansion of wireless networks (Wi-Fi) across all sectors of higher education. Wi-Fi networks in 2007 reached three-fifths (60.1 percent) of college classrooms, compared to half (51.2 percent) in 2006 and just one-third (31.1 percent) in 2004. "Wireless can be a wonderful resource for everyone on campus" and "it fosters access, mobility, and collaborative work among students and faculty" [The 2007 Campus Computing Survey].

Although many colleges and universities have full or partial implementations of Wi-Fi technology, most studies in the literature are limited to topics such as how to set up wireless networks, wireless standards, cost, technical problems, security concerns, and occupant health [Arabasz and Pirani 2002; Lu and Korukonda 2008; Demb, Erickson, and Harwkins-Wilding 2004; Green 2003a]. Little has been done to investigate Wi-Fi technology diffusion process among university faculty members. It has important practical implications to understand the diffusion process and perceived attributes of Wi-Fi technology, which will provide administrators with relevant information to address concerns of non-adopters and encourage more adoptions. This study fills the void by focusing on the perceived attributes of Wi-Fi technology and the diffusion gap among university faculty members. We use Rogers' [2003] diffusion of innovations theory as our analytic framework.

The next section provides an extensive literature review related to Wi-Fi technology in higher education and diffusion theories. The subsequent section is dedicated to the research design and research methodology. The collected data and results are presented next. Finally, we present theoretical implications and recommendations to address a "diffusion gap" between early adopters and the mainstream faculty.

II. LITERATURE REVIEW

Wi-Fi Technology in Higher Education

Wi-Fi technology opens a new dimension of computer networking in higher education. Wi-Fi technology affects not only the classroom environment and ways to access information, but also the actual activities of learning and teaching. Students, faculty, and staff can use their laptops with Wi-Fi in classrooms, libraries, or outdoors. "Higher education institutions feel the impact of computing freedom throughout their operation" [Arabasz and Pirani 2002].

The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards." It is important to note that Wi-Fi technology is used in tandem with laptops or handheld computing devices, such as PDAs, and mobile phones to allow users to access the Internet or corporate networks. Due to its mobility and simplicity, Wi-Fi has rapidly gained in popularity.

The surveys conducted by the Campus Computing Project [2007] revealed that Wi-Fi technology was an increasingly important issue across all sectors of higher education and showed "dramatic gains over the past year regarding campus planning for the deployment of wireless networks." More than three-fourths (76.7 percent) of the campuses participating in the annual survey had a strategic plan for deploying wireless in 2007, up from 68.8 percent in 2006 and 64.0 percent in 2005. More than a quarter (28.9 percent) of the institutions reported that full-campus Wi-Fi were running at their institutions in 2005, compared to 19.8 percent in 2004 and 14.2 percent in 2003 (Table 1). Green [2003a] said, "Wireless is clearly exploding across college campuses, much as it is in the corporate and consumer sectors."

Boerner [2002] listed some characteristics of wireless networking in higher education: mobility, installation speed and simplicity, installation flexibility, reduced cost of ownership, and scalability. According to the ECAR Respondent Summary [2002] study, most institutions implemented their Wi-Fi technology as a complement to current wired network operations. Dartmouth College reported: "We wanted to provide network access literally anywhere, indoors or outdoors." Another reason for implementing wireless is to augment wired networks to provide comprehensive network access. The University of Wisconsin Madison explained: "We had run out of space for additional computer labs. We were trying to find ways to reduce the long wait lines in our public computing labs. Since we knew 25 percent of the students who owned a computer had a laptop, we wondered if they would use a wireless area instead

of a lab." Others felt wireless represented a means to meet future computing needs. Florida State University reported: "The college of Law and MBA program in the College of Business wanted to deploy a laptop/wireless initiative. Both programs indicated this was becoming the norm for teaching in their respective disciplines to benefit students and faculty." Wake Forrest reported that they "wished not to be left behind."

Table 1. Percentage of Wireless Networks on Campus [Green, 2002; 2003a; 2003b; 2004, 2006, 2007]

Year	2007	2006	2005	2004	2003	2002	2001	2000
Strategic plans for wireless networks	76.7%	68.8%	64.0%	55.3%	45.5%	34.7%	24.3%	29.6%
Wi-Fi classroom	60.1%	51.2%	42.7%	31.1%	N/A	N/A	N/A	N/A
Full-campus wireless networks	N/A	N/A	28.9%	19.8%	14.2%	10%	6.2%	3.8%

According to Arabasz and Pirani's research of Wi-Fi technology in Higher Education [2002], the leading reason for wireless Internet was the desire to provide a greater degree of anywhere, anytime network access to students. Other reasons included meeting future computing needs, and improving classroom and faculty access to networks. Overall, Arabasz and Pirani [2002, p.11] stated that "wireless is considered a success in higher education. The vast majority of institutions using wireless networks say they have met or exceeded their expectations."

Although wireless Internet is becoming commonplace in higher education and many colleges and universities have full or partial implementation of wireless Internet, there are still many non-adopters across campuses (Lu, et al. 2007). While most studies in the literature focus on technical aspects of the technology such as wireless network set up, standards, cost, troubleshooting and security concerns, little has been done to investigate the perceived attributes of Wi-Fi technology diffusion process among university faculty members. This study uses Roger's diffusion of innovation theory to discuss the factors that affect diffusion of Wi-Fi technology.

Attributes of Innovations

One model for understanding technology diffusion is Rogers' [2003] theory of the diffusion of innovations. Rogers [2003, p. 5] defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system." In other words, the study of the diffusion of innovation is about how, why, and at what rate a new idea or technology spreads among the members of a social system. An innovation is an idea, practice or technology perceived as new by an individual [Rogers 2003]. The perceived attributes of innovations can help in understanding the rate of diffusion. Rogers outlined five distinct attributes that are strong predictors of an innovation's acceptance: relative advantage, compatibility, complexity, trialability, and observability. Relative advantage, compatibility, trialability, and observability are usually positively related to the rate of adoption, while complexity is usually negatively related to the rate of adoption.

Relative advantage means that an innovation has an advantage over other innovations or current practices [Rogers 2003]. Relative advantage indicates the benefits and costs resulting from adoption of an innovation and is one of the best predictors of an innovation's rate of adoption. The perceived relative advantage of an innovation is usually related to its rate of adoption in a positive direction. It means that "the greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be" [Roger 2003, p.15]. The degree of relative advantage can be expressed as economic factors, social motivations, incentives, and other benefits.

Compatibility is that an innovation is compatible with existing values, beliefs, and the needs of potential adopters [Rogers 2003]. The perceived compatibility of an innovation is positively related to its rate of adoption. Compatibility is the key factor for all innovations, even those with a high relative advantage. If the idea seems morally irreconcilable, then the innovation will not be adopted. To be implemented, an innovation must be considered socially acceptable. Rogers [2003] stated that an innovation could be compatible or incompatible with socio-cultural values and beliefs, previously introduced ideas, or client needs.

Complexity refers to the adopters' perception on the degree of difficulty to understand and use an innovation [Rogers, 2003]. The perceived complexity of an innovation is generally related to its rate of adoption in a negative direction. Some innovations are easily understood by most members of a social system and will be adopted quickly, whereas others may be more complicated and will be adopted more slowly [Rogers 2003].

Trialability means that an innovation can be tried on a limited basis before adoption [Rogers 2003]. Innovations that are trialable represent less uncertainty and will generally be adopted more rapidly than innovations that are not isolatable. Thus, the perceived trialability of an innovation is usually positively related to its rate of adoption. The trialability is more important for earlier adopters than later adopters, because earlier adopters have no precedent to follow when they adopt, while later adopters are "surrounded by peers who have already adopted the innovation" and "these peers act as a kind of vicarious trial for later adopters" [Rogers 2003, p. 258].

Observability is that an innovation offers observable results [Rogers 2003]. The perceived observability is related to the rate of adoption in a positive direction. The easier individuals can see the results of an innovation, the more likely they are to adopt it. According to Rogers [2003], a technology has two components: a hardware aspect that "consists of the tool that embodies the technology as material or physical objects," and a software aspect that "consists of the information base for the tool" [p. 259]. Since the software component of a technology is not so apparent, innovations in which the software is dominant are less observable and have a slower rate of adoption.

Therefore, Rogers [2003] argued that "innovations that are perceived by individuals as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations" [p. 16]. Because of differences in personal experiences, environments, and technology needs, faculty members will certainly perceive the attributes of Wi-Fi technology differently. As a result, we propose our first set of propositions for the diffusion of Wi-Fi technology among faculty members:

Proposition 1: the perceived attributes of Wi-Fi technology are different among faculty members. More specifically:

Proposition 1a: The perceived relative advantage of Wi-Fi technology is different among faculty members
Proposition 1b: The perceived compatibility of Wi-Fi technology is different among faculty members
Proposition 1c: The perceived complexity of Wi-Fi technology is different among faculty members
Proposition 1d: The perceived trialability of Wi-Fi technology is different among faculty members
Proposition 1e: The perceived observability of Wi-Fi technology is different among faculty members

Adopters Categories

According to Rogers' diffusion theory [2003], we know that individuals (or other decision-making units) do not adopt or reject an innovation at the same time. Therefore, there are different categories of adopters depending on the degree to which an individual is relatively earlier in adopting an innovation than other members of a social system.

Each individual's innovation-decision is largely framed by personal characteristics and this diversity is what makes diffusion possible. For a successful innovation, the adopter distributions follow a bell-shaped curve when diffused over time on a frequency basis (Figure 1). Diffusion scholars divide this bell-shaped curve to characterize the five categories of system member innovativeness, where innovativeness is defined as the degree to which an individual is relatively earlier in adopting new ideas than other members of a system. These groups are: 1) innovators; 2) early adopters; 3) early majority; 4) late majority; and 5) laggards.

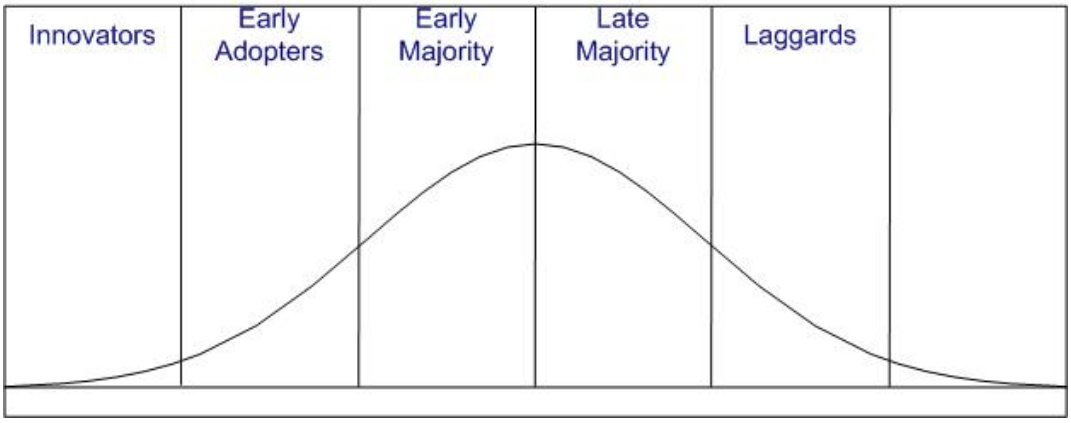

Figure 1. Adopter Categories

Adapted from "Diffusion of Innovations" by E. M. Rogers, 2003, p. 281. New York: The Free Press.

Innovators: Venturesome

Innovators are people who are considered risk takers and usually enjoy technology for its own sake (2 to 3 percent of the population). Innovators are venturesome types and "their interests in new ideas leads them out of a local circle of peer networks and into more cosmopolite social relationships" [Rogers 2003, p. 282].

Early Adopters: Respect

Early adopters are those who are able to adopt a technology to a specific situation that is important to them (13 to 14 percent of the population). According to Rogers [2003, p. 283], "Early adopters are a more integrated part of the local system than are innovators." Early adopters use the data provided by the innovators' implementation and confirmation of the innovation to make their own adoption decisions. This group earns respect for its judicious, well-informed decision-making and they serve as a role model for many other members of a social system. Rogers [2003] stated that "early adopters help trigger the critical mass when they adopt an innovation" [p. 283].

Early Majority: Deliberate

The early majority are the pragmatists who are willing to adopt a thoroughly tested technology if they easily see the advantages of using that technology (34 percent of the population). The early majority adopters deliberate for some time before completely adopting a new innovation [Rogers, 2003].

Late Majority: Skeptical

The late majority are skeptical of an innovation and reluctant to accept it (34 percent of the population). They may adopt an innovation when facing both an economic necessity and increasing peer pressure. When the late majority are convinced to adopt an innovation, the weight of system norms must definitely favor an innovation [Rogers, 2003].

Laggards: Traditional

Laggards resist technology and consistently question the use of technology (16 percent of the population). The last adopters, laggards, can either be very traditional or be isolated in their social system [Rogers 2003].

The Gap between Early Adopters and the Mainstream

Rogers [2003] said that the time element of the diffusion process allows us to classify adopter categories and to draw diffusion curves. The adoption of an innovation usually follows a normal, bell-shaped curve when plotted over time on a frequency basis. The segment of the diffusion curve between 10 to 20 percent adoption is the "heart of the diffusion process," and represents the transition from the "early adopter" to the "early majority." He commented that "the S-shaped curve of diffusion "takes off" once interpersonal networks become activated in spreading individuals' subjective evaluation of an innovation from peer to peer in a system" [p. 274]. The point is "critical mass," which "occurs at the point at which enough individuals in a system have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining" [p. 343].

Literature about instructional technology also describes the significant differences between early faculty adopters and the mainstream faculty. Geoghegan [1998] states that early adopters, who are risk takers, are more willing to experiment, generally self-sufficient, and interested in the technology itself. Mainstream faculty, on the other hand, are more concerned about the teaching and learning problems being addressed than the technology used to address them. Mainstream faculty view ease of use as critical, and want proven applications with low risk of failure. They usually require strong technical support (see Table 2).

Table 2. Early Adopters versus the Early Majority

Early Adopters	Early Majority
Favor revolutionary change	Favor evolutionary change
Visionary	Pragmatic
Project oriented	Process oriented
Risk takers	Risk averse
Willing to experiment	Want proven applications
Generally self-sufficient	May need significant support
Horizontally connected	Vertically connected

Jacobson [1988] discovered similar findings from the research on faculty innovativeness with technology for teaching and learning. She stated that early adopters often had different perceptions about obstacles to computer use than later adopters, mainstream faculty. While a majority of faculty agreed that lack of funds for hardware and the lack of technical support were obstacles, a larger percentage of mainstream faculty viewed the lack of technical support as more problematic than early adopters. Early adopters were more self-sufficient with regards to support and want more access to hardware resources for experimentation. Early adopters used computer technology mainly through self-training and assistance from colleagues.

Moore [1999] called the gap a "chasm" in his book *Crossing the Chasm*. The early majority and late majority comprise the "mainstream." "Chasm" was defined as the gap between "visionaries," early adopters who seize on new gadgets, and more mainstream "pragmatists" who need convincing before they adopt it. Moore extended Rogers' adopter diffusion model, and added a gap between early adopters and early majority (Figure 2).

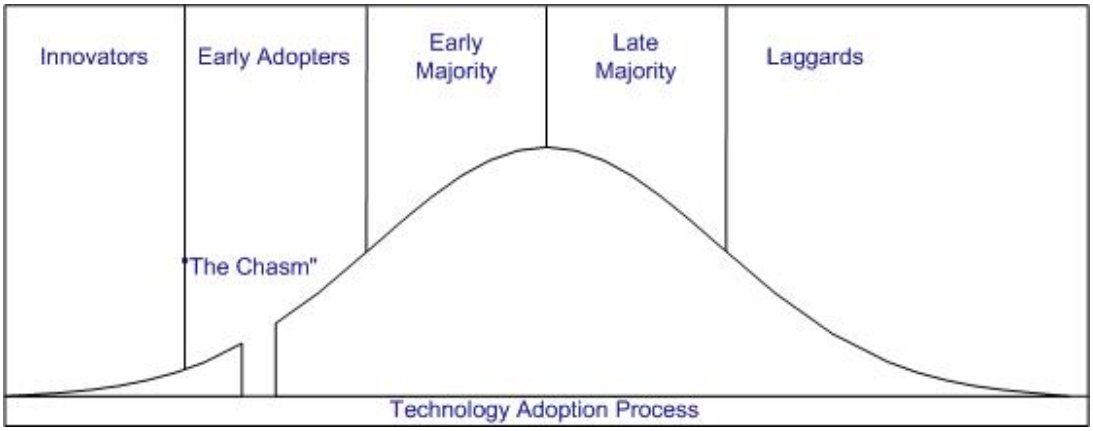

Figure 2. Revised Figure of Adopter Categories

Adapted from "Crossing the chasm: Marketing and selling high-tech products to mainstream customers" by G. A. Moore, 1999, p. 17. New York: Harper Business.

As discussed earlier, the perceptions of Wi-Fi technology attributes are different among faculty members. The differences will certainly lead to differences in their adoption decisions. As a result, we propose the second research proposition for the diffusion of Wi-Fi technology among faculty members:

Proposition 2: There is a diffusion gap between early adopters and early majority for Wi-Fi technology among faculty members.

III. RESEARCH DESIGN AND RESEARCH METHODOLOGY

The research questions for this study are: How differently are the innovative attributes (relative advantage, compatibility, complexity, trialability, and observability) of Wi-Fi technology perceived by faculty members in higher education? How do the differences lead to a diffusion gap of Wi-Fi technology among university faculty members?

To answer the research questions, qualitative research methods were employed. According to Patton [2002], one advantage of qualitative methods is that they "typically produce a wealth of detailed information" and "increase the depth of understanding of the cases and situation studies" [p. 14]. Denzin and Lincoln [1994] stated, "Qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter (and so) qualitative researchers deploy a wide range of interconnected methods, hoping always to get a better fix on the subject matter at hand" (p. 2].

Diffusion theory provides tools for both quantitative and qualitative research. Rogers [2003] distinguished variance research and process research. Variance research is "a type of data gathering and analysis that consists of determining the covariances (or correlations) among set of variables, but not their time order" [p. 196]. Most diffusion research is variance-type research, particularly the technology acceptance model (TAM] and its extensions widely used for IS diffusion research. This research is conducted using quantitative research methods, such as one-shot surveys and highly structured questionnaires. While variance research is appropriate for investigating variables related to innovativeness, it cannot measure the process dimension of data and cannot "probe backward in time to understand what happened first, next, and so on." [Rogers 2003, p. 196].

In contrast, process research is "a type of data gathering and analysis that seeks to determine the sequence of a set of events over time" [Rogers 2003, p. 196]. Process research is typical qualitative research using in-depth personal interviews. The strength of qualitative research methods lies in their helpfulness for understanding the meaning and context of the phenomena studied and the particular events and processes that make up these phenomena over time in real life natural settings. Hence, the wireless technology study was designed as process research to discover the technology diffusion process among faculty members. Because Wi-Fi technology is a new emerging technology that little research has focused on the diffusion process of faculty members in higher education, a qualitative research method is appropriate to discover the technology diffusion process among faculty members and understand what factors influence the diffusion process.

This study was designed to be a case study, involving one midwestern state university. Data were collected mainly through interviews. Semi-structured in-depth interviews were used to let the participants explain their perceived attributes of Wi-Fi technology.

Research Participants

This study focused on faculty members at the university who used Wi-Fi technology in instruction and research. The participants included 16 faculty members (nine male and seven female) from six colleges of the university. Among them were nine adopters and seven non-adopters (Table 3).

Table 3. Faculty Participants

	Wi-Fi adopters	Wi-Fi non-adopters
College of Arts & Sciences	4	5
College of Education	2	1
College of Communication	1	
College of Health and Human Services		1
College of Fine Arts	1	
College of Engineering and Technology	1	
Total	9	7

The exact number of faculty members of the university who used wireless Internet was very hard to determine. Communication Network Services (CNS) was expanding the wireless coverage to an increasing number of departments and buildings. Some departments had their own wireless Internet devices, like wireless carts and access points. Furthermore, some faculty members had wireless devices at home, and it was difficult to determine whether they were adopters. This led to increased difficulty of identifying the population of faculty wireless adopters at the university.

Multiple approaches were used to recruit participants:

- The researchers conducted a pilot study and identified several faculty members who were wireless Internet adopters by taking advantage of the information of departments and programs that had wireless equipment and supported faculty to use the technology.
- The Center for Innovations in Technology for Learning hosted a series of seminars during the fall quarter, 2004, which was aimed at incorporating wireless technology. The seminars helped faculty develop methods for using wireless tools in their teaching. The fact that one of the researchers participated in these seminars as an observer also helped recruit participants.
- More faculty and administrator participants were identified through snowball sampling strategy. Snowball sampling is to ask interviewees to recommend prospective participants. The snowball sampling worked very well and lists of participants were obtained through recommendations of the interviewees. Nine out of a total of 16 interviewees were identified through this sampling strategy.

Through these efforts, 16 from six colleges of the university were recruited. The researchers were conscious of maintaining respect and dignity toward the participants throughout the study. The participants' limits of accessibility were respected and the agreement regarding time allotted for the interview was heeded.

Data Collection: Semi-Structured In-Depth Interviews

The researchers used semi-structured in-depth interviews to let the participants explain their experiences to adopt or not adopt Wi-Fi technology.

Unlike structured interviews, which are strictly planned and controlled beforehand with every possible interview question, a semi-structured interview is conducted with a fairly open framework, where a number of interview questions are prepared in advance based on the research questions and theoretical framework. These questions are open enough to initiate subsequent questions that cannot be predicted [Wengraf 2001].

Contrary to common beliefs, semi-structured interviews are fully prepared and planned in advance. According to Wengraf [2001, p. 5], semi-structured interviews are even more difficult than fully structured interviews because successful semi-structured interviews require:

- Thorough preparations before the session
- More discipline and creativity in the session
- More time for analyzing and interpreting the results after the session

Similar to unstructured interviews, semi-structured interviews will have a written set of topics and questions. In unstructured interviews, the interviewer will guide the interviewee minimally, and the interviewees will form their own responses to questions and let the responses go in any direction they want. In contrast, a semi-structured interview will have an interview guide that specifies both the questions and the manner in which the questions should be asked. The guide is very important for the interviewer to collect comparable qualitative data from one interview subject to another [Bernard, 2002].

In addition, semi-structured interviewing needs to be in depth. In other words, the interview will not stop at the level of appearance, but will go deep inside the reality to see how complicated things are. In order to do so, the majority of the interview questions are formed during the interview, so as to allow flexibility for both the interviewer and the interviewee to discuss details and issues. The semi-structure format provides an opportunity to probe for what is unknown on a certain issue, or gain different perspectives and a range of insights.

Two sets of interview protocols were developed for faculty adopters and faculty non-adopters, respectively (see Appendix). According to Rubin and Rubin [1995], an interview protocol ensures that the direction of the conversation is relevant to the issues concerned. Researchers need a certain control of the interview and yet at the same time should know not to control too much. The protocol questions are there, but researchers should be flexible so as to leave the questions open-ended for the interviewee to talk about their experiences in depth. For this case study, a set of protocol questions was designed based on the theories of diffusion of innovations and factors affecting the diffusion process. Therefore, in this study, the interviews had structures around the issue of the diffusion process, communication channels, time and the social system. At the same time, the interviews were open to unexpected events because the experience of each adopter was different and they were designed to find out as much as possible about the construction and reconstruction of meaningfulness of Wi-Fi technology for an adopter during the diffusion process. The protocols were reviewed and adjusted after the first several interviews in order to gain richer information in subsequent interviews. Relevant questions were emphasized and added. Irrelevant ones were reduced.

The interviews were organized through telephone calls and emails to get the permission of interviewees about the time and place of interviews. Follow-up questions were via e-mail or face-to-face depending on the situation.

Since different participants had different responses to the questions, probing questions were asked for more details and clarification. According to Rubin and Rubin [1995], “Probes signal the interviewees that you want longer and more detailed answers, specific example, or evidence…they ask the interviewee to finish up the particular answer currently being given and they indicate that the interviewer is paying attention” [p. 148].

The interviews were recorded on tape for transcription. Extra batteries and tapes were ready to avoid the unexpected situation. All the interviews were done face-to-face. All the records were kept confidential and the researcher protected the participants’ privacy by not using their names or other unique identifying characteristics in any of the reports.

IV. RESULTS

As aforementioned, the perceived attributes of innovations can help in understanding the rate of diffusion. Attributes of innovations include relative advantage, compatibility, complexity, trialability, and observability. The findings related to each attribute are reported following.

Relative Advantage

Rogers [2003] defined relative advantage as "the degree to which an innovation is perceived as better than the idea it supersedes" [p. 15]. In this study, relative advantage is to what extent faculty members perceive Wi-Fi technology to have a relative advantage over wired access. Relative advantage of Wi-Fi technology is expressed as a degree of economic profitability, convenience, and time and effort.

Economic Profitability

Almost all of the wireless adopters expressed that a wireless cart is a great savings for the university compared to a traditional computer laboratory. A traditional computer lab is a classroom where students are provided desktop computers connected to the Internet, and teachers are provided with an Internet-wired computer whose output is projected onto a screen. A wireless cart is a portable cart, which contains 15 to 30 wireless laptops with built-in wireless cards. Professors can move the cart to any classroom and distribute wireless laptops to students, which is a savings for the university and convenience for students. An English faculty member commented that:

> F4: We are a high-technology language program. We use our computer lab a lot. It's busy. We thought the wireless cart a way of creating another lab environment that could be used when the first lab is busy. Not only that, because it would be portable, it could go in any classroom.

Although the adopters mentioned that Wi-Fi technology infrastructure is less expensive than wired Internet infrastructure, the non-adopters were not aware of the advantage. If one wants to use wireless Internet, he/she needs a laptop with wireless capability. Therefore, from a non-adopter's perspective, Wi-Fi technology hardware may have a high initial cost. One faculty non-adopter was even worried about the cost associated with wireless Internet:

> F15: Of course if we need to pay for that, I will not use that. I think that's another issue. If the university would make it available to everybody, it won't hurt a lot to try. But there are some fees there, they may need to consider. Also, even though the university would offer free access, it might have some negative effect on budget in general. Maybe it's not good idea to try, especially in this budget tight situation… That's my opinion on that.

Convenience

The advantages that faculty mentioned most were convenience, portability, and mobility. One faculty adopter from the department of Computer Science said:

> F1: I can move anywhere: take the laptop to the classroom or to the conference room and always access the Internet.

One English faculty member reported that wireless technology was more convenient than a traditional computer lab.

> F4: It (wireless technology) could accommodate smaller groups of students so you won't have to use the entire computer lab if you have a group of five or six students, which we often have. We thought first it would just be convenient for those purposes. Now I am leaning in the direction of having no traditional computer labs and only have wireless labs because we then save on space and any room is potentially a computer lab. This is one of the many advantages of wireless.

Even the faculty members who did not use wireless Internet understood the convenience. One faculty member from the College of Health and Human Services said:

> F15: Should be very convenient, I think. Say, sometimes we meet in the old buildings where we have no access to the Internet by cable. Sometimes we meet in Perks coffee shop, where of course they don't have the tech. If we have the wireless Internet, it would be perfect.

Therefore, the mobility and convenience of wireless technology brings greater flexibility of teaching practices in class.

Time and Effort

Time and effort are needed for the adoption of any technology. Faculty members are always busy. They not only teach classes, but also do research and have service commitments. If a technology does not relate to their interests or research or if they do not have any profound instructional needs for it, many of them will not spend time and effort to adopt it. Although wireless technology is easy to learn and use, it takes time and effort to employ for class teaching. A language faculty member commented that:

> F2: I know the university has the push for wireless and I think it's great. Wireless technology is like anything, you mean, there are all kinds of real cool things out there. You have to decide where you can spend your time. I think that's probably one of the big reasons that people don't get involved because people are busy. You can barely do what you are supposed to do and try to add something on it. If it's pretty easy to do, it's ok. If it requires any kind of effort, I think it's (hard), unless the university really commits to it. The big thing is time. Most people work hard. You will give something else up. What will they give up?

In summary, while the faculty adopters considered that Wi-Fi technology was cost effective, the non-adopters did not perceive the economic profitability. All faculty members mentioned that the most important advantages of Wi-Fi were its convenience and mobility. They felt that it took time and effort to employ Wi-Fi for class teaching.

Compatibility

Compatibility is another attribute that will influence an innovation's diffusion and adoption. Rogers [2003] said that an innovation can be compatible or incompatible with socio-cultural values and beliefs, previously introduced ideas or client needs for the innovation. The findings of the current study showed that compatibility is a salient factor that influenced faculty members to adopt Wi-Fi technology.

Compatibility with Values and Beliefs

Studies have shown that instructors, who believe in social constructivism and are more reflective of their own pedagogical beliefs, are generally likely to implement technology in the classroom [Zhao, Pugh, Sheldon, and Byers 2002]. Social constructivism sees learning as a dynamic process in which learners construct new ideas or concepts based on their past knowledge and social and cultural environments. It implies the notion that learners do not passively absorb information but construct it themselves [Vygotsky 1962; 1978].

In this study, six out of nine wireless adopters mentioned that they believed in social constructivism and considered Wi-Fi technology fitting their beliefs. One language professor (an adopter) said:

> F2: I don't like to stay at the front of class to talk. That's usually the minimum part of my class. It (wireless) fits my (teaching) style well. And I think it teaches the students along with the great information on the Internet as well as there is lot of bad (information). They have to think and construct and do a lot of problem solving and critical thinking. When they find sources, they will have to decide. We spend a lot of time on evaluating.

A professor from the College of Communication stated that the wireless technology fit her constructivist teaching style. She said:

> F7: I used to pair the students and let them work as team. Let them going through the process and trying to create something. I'm trying to do the constructivism and then they can create and construct something. When they plug it to the overhead and projector, they can present and justify their ideas.

In contrast, almost all non-adopters said that wireless was incompatible with their instructor-centered teaching style. They did not perceive Wi-Fi technology as an improvement to their traditional teaching methods. A non-adopter said:

> F13: I don't use the computers a lot in the classroom. I use it lot in presenting the material, accessing Blackboard or showing people the resources on the Web. It's kind of teacher control. I don't do a lot of student control.

A language instructor said that the technology might not be useful in her language classes because she valued oral communication.

> F12: I don't think it would be so good for all of our students. My course is about language. My class is more about communicating. Internet will help some way but it can't be used as main teaching method.

Therefore, the use of technology must fit the faculty's teaching philosophy and style. Faculty members who were less reflective of their own pedagogical beliefs were more reluctant to change. One History faculty summarized the attitudes of non-adopter colleagues about technology:

> F14: (They think) I may have to give up something or some portion of the time that I now spend on lecturing in order to integrate the new technology into my teaching. And I don't want to do that. I set up 50 minute-lectures that I give. If I would try to use the new technology, I don't know what I would drop or what I would edit out of the lecture that I currently give.

Compatibility with Needs

An innovation is adopted because it is perceived to meet the needs of potential adopters. Most of the adopters perceived the Wi-Fi technology met their mobile computing needs. One professor commented that:

> F4: I think one of the things that really motivated our faculty to use it for their own purposes is that as the campus becomes wireless they can use it anywhere. So they can take their laptops home with them or to the Alden Library, down the hallway to meet with the students, to anywhere while still working with the same stuff. I think that portability makes people think about the use of the technology a lot differently, because otherwise, it was always something that I keep in my office. Computing or thinking about technology is something I do in office and only in my office. Now it's more part of their lives.

However, because every office and classroom already had wired Internet connections, Wi-Fi technology was merely adding an alternative connection. Some faculty members did not yet find a need for Wi-Fi. Almost all faculty non-adopters commented that they were satisfied with the current technology and they didn't feel a need to go Wi-Fi. A non-adopter faculty commented that:

> F14: I wouldn't know because in fact each of the classrooms in Bentley has a computer with Internet connection available. So anything I want on the Web I can bring up and also display through the video projector on the screen. A Wi-Fi connection won't be a benefit to me in addition to what I have now. And I don't need it in my office because I get an Internet connection there on the computer. At home I get a Road Runner on that computer. I couldn't really tell you how I would use Wi-Fi in my teaching.

To sum up, between the adopters and the non-adopters Wi-Fi technology was perceived differently in regard to compatibility. Adopters considered that Wi-Fi was compatible with their constructivist teaching philosophy, technology-related teaching subjects, and their mobile computing needs, whereas the non-adopters did not consider Wi-Fi to be compatible with their instructor-centered teaching styles and their computing needs.

Complexity

Complexity is "the degree to which an innovation is perceived as difficult to understand and use" [Rogers 2003, p. 17). From the adopter's perspective, Wi-Fi technology worked exactly the same way as wired Internet, and so it was not necessary to learn any new skills. Almost all the faculty reported that Wi-Fi technology was easy to use. An instructor from the music department said:

> F5: Oh yeah. It (Wi-Fi technology) is easy to use. It took me a while to get signed on to process everything. But automatically if I open my browser, it'll take me to that location (OU wireless login page).

Although Wi-Fi technology works the same way as wired Internet, faculty members may need instructions to set up wireless cards or troubleshooting, particularly for those who have limited computer technology knowledge. For example, one instructor interviewed had a new laptop with wireless capability, but she did not use it because she did not know how to set up the wireless card and access the wireless network.

> F12: I'm not a computer person. I always have problem using computer. I don't' know how to set up the wireless card.

Trialability

Trialability means that an innovation can be tried on a limited basis before adoption [Rogers 2003]. One needs a laptop with wireless capability to have the benefits of wireless Internet. Lacking a laptop prevents many opportunities for trying the benefits of Wi-Fi technology.

A technology cluster consists of one or more distinguishable elements of technology that are perceived as being interrelated. An innovation may be perceived as an interrelated package of new ideas. The technology cluster effect is common for many technology adoption processes. For example, a computer is needed for the Internet adoption and a PDA is needed for mobile commerce adoption. The wireless technology can be considered as a cluster because it includes Wi-Fi networks and mobile computing devices, such as laptops, pocket PC, and PDA. Thus, a wireless technology cluster means that wireless technology has a low degree of trialability for its need for additional hardware.

To overcome the low degree of trialability, each of the three colleges had one or two wireless carts, which contained 15 to 30 wireless laptops with built-in wireless cards. These technology packages enabled instructors and students to take advantage of Wi-Fi in case they did not own laptops.

Observability

Observability is "the degree to which the results of an innovation are visible to others" [Rogers 2003, p. 16]. The wireless signal is not visible. When people use wireless laptops in a library, in class, or in the hallway, other people do not know whether or not they are accessing the Internet. However, some degree of observability can still be observed. For example, only three out of the 16 faculty members mentioned that they were aware of the technology from observing others using it. An adopter said:

> F7: I think it started from the time when I noticed many American students were surfing the Internet while sitting in this building. Then I was very curious and talked with friends about the new wireless cards.

Therefore, although some faculty members noticed the Wi-Fi technology from observing others, it did not have a high degree of observability overall.

In summary, although Wi-Fi technology was perceived "convenient and mobile" by all the faculty members, it was perceived differently between the adopters and the non-adopters in the other aspects. The adopters considered that Wi-Fi had relative advantage in economic profitability, while the non-adopters did not perceive this relative advantage. The adopters perceived that Wi-Fi was compatible with their teaching philosophy, practices, and needs; whereas the non-adopters did not agree. Although Wi-Fi was generally perceived as easy to use, some faculty members needed assistance to set up and troubleshoot wireless cards. For those who did not have a wireless laptop, Wi-Fi had a low degree of trialability. Wi-Fi did not have a high degree of observability overall (Table 4).

Table 4. Summary of Perceived Attributes of Wi-Fi Technology among Faculty Members

		Adopters	Non-adopters
Relative advantage	Economic profitability	Yes	No
	Convenience	Yes	Yes
	Time & Effort to employ for teaching	Yes	Yes
Compatibility	With values & Beliefs	Yes	No
	With needs	Yes	No
Complexity		No	Yes
Trialability		Yes	No
Observability		No	No

Adopters' Categories and Diffusion Gap

Following the definition by Rogers [2003], we classified four of the members as innovators and five members as early adopters (Table 5). At that time of the study, Wi-Fi was still in the early adoption stage, and it had only reached the innovators and early adopters but not yet the early majority, late majority, and laggards.

Table 5. Adopters' Categories			
	Adopters		Non-adopters
	Innovators	Early-adopters	
Number	4	5	7

The four faculty innovators of wireless Internet at the university obtained information about wireless technology from outside of the local circle. They adopted the technology before the university had the campus-wide network. One innovator was a faculty member who taught linguistics and English classes. He had set up a wireless network in his house before the university had a wireless network. When answering the question, "How did you know about the wireless technology?" he explained that:

> F4: I think maybe I got the information from the *Syllabus*, a magazine. It may have been initially from the Apple Web site because Apple started with Airport software pretty early. It's either from the Apple Web site or the Apple user's group. We got a lot of information from these. We rely on their innovations to fuel us for each generation.

The second innovator was a faculty member of EECS (Electrical Engineering and Computer Science). He had used wireless Internet before he came to the university.

> F1: I am a computer scientist, and this is my field. I watched it developed. I bought a wireless card for my notebook when I was a student. Wireless network was available a few years ago and I was a student three years ago.

The third innovator was a faculty member from the department of modern languages, also the director of the language resource center, where he started the first wireless project on campus. He knew about wireless technology from attending conferences and reading articles.

> F6: I got the idea because I went to two conferences. I mean I read articles that are interesting… It had just started out. The wireless cards became affordable. Apple started… We are actually the first wireless project on campus.

The fourth innovator was a faculty member from the School of Communication Systems Management. He said he was one of the initiators who proposed the wireless network covering all the campus. He knew the wireless technology from reviewing technology reports and articles.

Whereas innovators are cosmopolites, early adopters are localities and they generally know the innovation from interpersonal channels [Rogers 2003]. Early adopters are a more integrated part of the local system than innovators. There were five faculty members who could be seen as early adopters in this study. They obtained the wireless technology information from their peers, friends, or students. One English professor said:

> F2: I found out about the (wireless) cart from XX (one colleague) and from the announcement in the building. We have the cart available… We talked lot about the ways to use it, things that have been successful, and things that have happened.

Another professor from the College of Education said:

> F3: One of my faculty members, XX, went to our meeting and introduced it, telling us there are wireless carts available for us to borrow.

Another professor from the music department knew the technology from students and a colleague.

> F5: I actually noticed the students out in the lobby getting online. The librarian here, XX, let us know there is wireless (access points) in the library.

Non-adopters also learned about the wireless information from friends and colleagues. When one faculty from the education department answered the same question, "How did you know the information about wireless technology," she said:

> F10: My friends. I see people use it (wireless Internet).

Another faculty member knew the wireless from the wireless network reminder window on her laptop screen. One linguistics professor and one English professor learned the information from their colleagues and the technology staff. There was a wireless cart in their building, called MacMobile. The technology staff offered a workshop to learn how to use the wireless cart.

One professor in the College of Health and Human Services learned the technology from her colleagues and technology staff.

> F15: I heard that from other faculty members. They are talking about that. One day we had a staff (member) coming from CNS. He mentioned the wireless service was available on campus. I am not very sure. Not very often, but I heard people talked about it.

In summary, the wireless innovators obtained the information most often from mass media channels: journals, articles, and conferences. The early adopters and non-adopters were likely to know the information from interpersonal channels: colleagues, friends, technology staff and students.

V. DISCUSSION

In summary, this study used Rogers' diffusion theory to examine the Wi-Fi technology among university faculty members. Findings from this study showed that that there were differences between early adopters' and non-adopters' perceptions of Wi-Fi technology. They were different in such aspects as technology knowledge and skill, teaching practices, teaching philosophy, and technology needs. In addition, they were at different diffusion stages. The innovators and the early adopters would quickly adopt Wi-Fi. However, the majority of faculty members who had a more practical and deliberate perspective on Wi-Fi tended not to adopt the technology if institutional factors (technology infrastructure and human infrastructure) were not in place. These differences led to a diffusion "gap" between early adopters and non-adopters.

In this Wi-Fi technology study, the innovators or early adopters of wireless technology were intrinsically motivated, self-taught, and experimenters, who were confident and efficacious in technology. Their teaching philosophy and practices tended to be based on social constructivism and student-centered learning. On the other hand, the mainstream faculty members were more intimidated by the new technology and needed different kinds of supports from what are required by the early adopters, such as user-friendly manual, guide, additional training and/or incentives.

For Wi-Fi technology in this study, it was perceived to have great instructional potential in teaching and learning by the early adopters and they had easily accepted the technology. However, it may not be compatible with the mainstream's teaching values and philosophy. Wi-Fi technology supported more a student-centered learning environment. Although it was easy to use, it had a low degree of trialability and observability. It was not easy to undertake for the first time and was not obviously observable. As a result, the mainstream faculty did not accept Wi-Fi easily.

Apart from the characteristics of adopters, it is also important to consider the technology itself, and the attributes that make it attractive or unattractive to potential adopters. Rogers [2003] states that five attributes of innovations influence their rate of adoption. If an innovation performs well on these attributes, with good relative advantage, excellent compatibility with existing practices and norms, a low level of complexity, ease of use on a trial basis, and easily observed results, it would be susceptible to rapid adoption.

Geoghegan [1998] suggests that relative advantage may play the most important role in early adopter acceptance. Complexity, compatibility, and trialability, on the other hand, seem to have a much stronger influence on the mainstream, who are a more deliberate, pragmatic, and skeptical group. Complex and sophisticated technologies often progress only as far as the early adopters, but fail to reach the mainstream. For example, a decade ago, multimedia and CD-ROM were commonly seen as the technologies most likely to foster improvements in teaching and learning. Although the use of multimedia and CD-ROM was growing, their growth and adoption rates were outstripped by the use of the Internet and e-mail. The reason was that Internet and e-mail scored high on complexity, compatibility, and trialability: they were not difficult to use; they were easy to try out; and they were compatible with academic values that emphasize communication and group work and active learning. On the other hand, multimedia and CD-ROM scored low on all three of these characteristics despite their generally accepted pedagogical advantage. The result was that the Internet and e-mail obtained mainstream acceptance, while multimedia and CD-ROM did not.

For the wireless technology in this study, it was perceived to have great instructional potential in teaching and learning by the early adopters and they had easily accepted the technology. However, it may not be compatible with

the mainstream's teaching values and philosophy. It had a low degree of trialability and observability. It was a complex process to set up Wi-Fi for teaching and learning in classroom. Therefore, the wireless technology did not easily obtain mainstream faculty acceptance.

Diffusion theories help us understand why we were not so successful with the adoption of Wi-Fi technology. Universities are dealing with two distinct populations that have different interests and needs. The early adopters, who have technology skills and enthusiasm, need leading edge technology, advanced technical assistance, and funding for new projects. The mainstream faculty members, who are less familiar with technology, need more time, incentives, ongoing support, and instructional design assistance [Geoghegan 1998; Jacobsen 1998].

Change agents in the administration (from the president, to deans, to department heads), and early adopters and mainstream faculty, need to sit down to discuss an instructional technology integration plan to bridge the gap. The technology integration plan should address the needs of mainstream adopters, by capitalizing on the knowledge and skills of early adopters, and the support structures of various organizations. Mechanisms for sharing valuable information among faculty and administrators must be provided. The mainstream faculty members need to contribute their point of view, their motivations, and their needs so that a common ground can be reached [Gilbert 1996].

The early adopters discover and overcome barriers in their attempt to integrate this innovation, and develop and contribute to a collective knowledge base concerning instructional technology. Early adopters make an innovation visible to the mainstream and decrease uncertainty about the innovation. The early adopters can play an important role in the instructional technology integration plan on campus. As opinion leaders, early adopters can persuade other mainstream faculty to adopt the use of technology [Rogers 2003].

The mainstream faculty members are usually deliberate and skeptical toward technology. They have a wait-and-see attitude toward a new technology. The mainstream can play a more active role in the technology integration plan. They usually need assistance on where to start with integrating the technology into curriculum. They could learn from their colleagues' successful practices and share experiences with them.

The mainstream faculty should participate in planning and decision-making activities that set the direction for instructional technology, such as strategic planning committees, university and department computing committees, technology task forces. The traditional model for staffing such groups tends to seek out faculty who are knowledgeable about technology and who have a strong interest in technology—innovators and early adopters. The mainstream faculty could be involved in these technology decision activities and committees to speak out about their needs and interests.

In this study, the compatibility of the technology with the faculty's teaching philosophy was an important factor that influenced the technology diffusion. Universities need to encourage the mainstream faculty to develop and implement technology based on their philosophy and pedagogy of teaching. Geoghegan [1998] recommends using an instructional team approach to design courses. Let faculty members serve as the content experts for the courses. Use an instructional designer to handle the pedagogical aspects. Employ a technologist to address issues related to hardware and software requirements. To be more effective, the instructional designer can explain the educational beliefs and philosophies behind the course redesign.

VI. CONCLUSION

The findings presented in this study have both theoretical and practical significance. This study found additional evidences to support Rogers' [2003] theory of the diffusion of innovations. Based on findings at this institution, a diffusion gap was identified between the early adopters and the mainstream faculty in Wi-Fi technology adoption. The gap is a result of differences in faculty's knowledge and skill of technology, teaching philosophy, and technology needs.

This diffusion gap implies that an effective adopting plan needs to take into consideration different characteristics of early adopter and mainstream faculty. Like Wi-Fi technology, many instructional technologies are widely adopted by innovators and early adopters, but limitedly adopted by the mainstream faculty. These two groups have different characteristics, motivations, and needs in instructional technology. If the technology integration plans are developed on the assumption that everyone will naturally use technology as readily and easily as the early adopters, then they are bound to fail. By recognizing the differences between the early and the mainstream adopters, faculty members can help plans more relevant and targeted. That is, instead of relying on serendipitous diffusion to bridge the "chasm" between early adopters and the mainstream faculty, the technology integration plan needs to combine the different stakeholders' perspectives and interests, including early adopters and opinion leaders, the mainstream, and the administrators.

Based on our findings, we make the following recommendations for future research to deepen our understanding of instructional technology diffusion in higher education.

1. When we consider the wireless technology as a cluster, it would include Wi-Fi networks and mobile computing devices, such as laptops, pocket PC, and PDA. Adopters need a laptop to use the Wi-Fi technology. Future studies should take into consideration this laptop factor as a potential hidden variable.
2. Faculty members may decide not to adopt Wi-Fi technology in their classrooms for various reasons. Among them are adherence to a teaching style, possession of computer skills, and personal preferences. Roger's diffusion model may not be adequate to accommodate for all of them. Future research may want to consider other frameworks to further explain the adoption decision.
3. Our study investigated faculty members' adoption of Wi-Fi technology at a public state university. Further research is needed to understand faculty technology adoption in a wide range of colleges and universities.
4. This study focused on only Wi-Fi technology adoption among faculty members. Future research could be expanded to other instructional technology, such as, e-mail, multimedia software, smart phones, e-portfolio, etc. It would be interesting to investigate the different diffusion rates among these potential instructional technologies and to see whether there is the same diffusion "gap" between early adopters and the mainstream.
5. Future research is needed to examine the adoption of the wireless technology over time. This study was conducted at an early stage of adoption of the wireless technology and not so many faculty members had adopted it, yet. Further research is needed to identify adopter categories and, particularly, to examine the needs and perceptions of the mainstream faculty (the early majority and late majority).
6. Future research is needed on variance-type quantitative research. This study is process research that focused on the technology diffusion process among faculty members and discovered the strategies and models for encouraging more adopters. Diffusion theory provides well-developed concepts and tools for both quantitative and qualitative research. Further variance research is needed to determine covariance (or correlations) among set of variables influencing the wireless technology adoption. These variables may include attributes of the technology, personal technology skill, personal innovativeness, and end user support.

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APPENDIX: INTERVIEW PROTOCOLS

Part 1: Interview Questions for Faculty Adopters

1. Factors that influence to use wireless technology
    1) First, could you please tell me a little bit about yourself?
       Probe 1: What courses do you teach?
       Probe 2: How long have you taught at the university?
    2) Can you describe your instructional technology (computer technology) level? Novice, intermediate, or expert?
       Probe 1: What computer skills do you have? Such as what programs you used, or what do you do using computers?
       Probe 2: In your view, how does technology add value to the teaching and learning process?
    3) Did you receive any instruction about effective use of wireless technology? If yes, what are these instructions? If no, how did you gain skills to use wireless Internet?
       Probe 1: What aids or supports would you use for wireless Internet?
       Probe 2: What types of technical support have you found to be most helpful?
    4) Do you think whether it will change your teaching style in some ways if using wireless Internet in classrooms?
    5) What problems or concerns do you have about using wireless Internet? How comfortable do you feel about using it? What personal value do you see in using it? Do you have any other reservations about it?
    6) What do you consider to be a sensible balance of payoff or value vs. the time if takes to learn how to use wireless Internet?
    7) What roles do administrators play in facilitating the diffusion of wireless Internet?
    8) Who play an important role in the project?

2. Perceived attributes of wireless Internet
    1) To what extent do you use wireless Internet?
       Probe 1: How do you use wireless Internet? Such as, locating instructional material, sharing or disseminating information, accessing electronic articles, communicating, or others.
       Probe 2: what was your most memorable experience with wireless Internet? What caused that experience to be so memorable?
       Probe 3: Could you describe how you use technology in teaching your class?
    2) How do you feel about wireless Internet? What do you think of it? What is you attitude toward it?
       Probe 1: What are the advantages of wireless Internet compared to wired Internet? Such as for your teaching, research, and communication.
       Probe 2: Any problems or concern you have about it? Do you have any reservation about it?
    3) What are the factors that attract you to use wireless Internet in your teaching?
    4) How did the students response to your using wireless technology in your teaching in your classroom? What did the students say about your technology use?
    5) Does it require a lot of training and practice to use wireless Internet?
    6) Is it possible to integrate wireless Internet into your teaching, research, and management?
       Probe 1: Is it possible for an instructor to combine wireless Internet with other methods to teach in a classroom? If yes, in which ways? If no, why not?
    7) Are there other possible ways that you might discover or hear from your colleagues that you can use wireless Internet?
    8) Did you meet any problems when using wireless Internet? If yes, how did you solve it? Did you get any assistant?
       Probe 1: Did you have any problem to set up the wireless Internet device (driver)?
    9) How does wireless Internet affect you or others you know?
       Probe 1: Do you feel that wireless Internet is compatible with your own lifestyle or personal philosophy?
       Probe 2: How does it fit into your teaching philosophy?
       Probe 3: What kinds of changes are you making in your use of wireless Internet?

Part 2: Interview Questions for Faculty Non-adopters

1. Factors that influence to use the wireless technology
    1) First, could you please tell me a little bit about yourself?
       Probe 1: What courses do you teach?
       Probe 2: How long have you taught at the university?

2) Can you describe your instructional technology (computer technology) level? Novice, intermediate, or expert?
   Probe 1: What computer skills do you have? Such as what programs you used, or what do you do using computers?
   Probe 2: In your view, how does technology add value to the teaching and learning process?
   Probe 3: Could you describe how you use technology in teaching your class?
3) Did you receive any instruction about effective use of wireless technology? If yes, what are these instructions? If no, how did you gain skills to use wireless Internet?
   Probe 1: What aids or supports would you use for wireless Internet?
   Probe 2: What types of technical support have you found to be most helpful?
4) Do you think whether it will change your teaching style in some ways if using wireless Internet in classrooms?
5) What roles do administrators play in facilitating the diffusion of wireless Internet?
6) Who play an important role in the project?

2. Perceived attributes of wireless Internet
1) How do you feel about wireless Internet? What do you think of it? What is you attitude toward it?
2) From your viewpoint, what are the advantages of wireless Internet compared to wired Internet? Such as teaching, research, and communication.
3) How do you envision yourself using wireless Internet to support your teaching, research, or communication?
   Probe 1: Is it possible for an instructor to combine wireless Internet with other methods to teach in a classroom? If yes, in which ways? If no, why not?
4) Are there other possible ways that you might discover or hear from your colleagues that you can use wireless Internet?

ABOUT THE AUTHORS

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